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Technical Note

Experienced knowledge for the description of maintenance packages

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ABSTRACT

The presented work is included in the research theme that specifies some means of capitalization and exploitation of knowledge from experience feedback processes in the context of industrial maintenance management. Our research on it is a more precise definition of the proposed project, built with a problem asking how to handle the management of repair packages. Upstream, the knowledge of various experts are materialized in the form of expert reports. Downstream maintenance wants to quickly repair products based on symptoms or change parts in advance. For this, we propose a methodology by analysing the feedback to improve the response time for maintenance services. This is implemented in the context of a manufacturing traction motors for the railway industry.

1. Introduction

The industrial maintenance services and their associated logistic organizations attach great importance to the work of the experience feedback processes to further enhance the schemes and frameworks in the future in order to keep meeting user requirements and to ensure that service levels improve continuously [1]. The timing of the events, which appear to be very similar, is a strong incentive for seeking common causes and carefully scrutinizing the experience feedback that can generate interesting lessons learnt with significant generated knowledge in the context of industrial maintenance. Capitalize these maintenance knowledge and promote the sharing of expert knowledge promotes some cross viewpoints to improve collaborative decision making [2]. The corresponding continuous improvement process depends on basic understanding, learning from experience, working together and training [3–5]. The functional analysis and the produced information with the gained experienced knowledge are important for some developments leading to the legitimization and trivialization of a type of traceability system that is reliable, robust and comprehensive [6–8].

Experience feedback management will better exploit empirical knowledge to anticipate repairs by directly applying packages, which will create a real time saver and therefore money for the company [9]. It must be kept in mind that in some markets, the time is more important than the cost of creating and repair packages can avoid having to make estimates and can enable a company to meet the needs of customers.

Currently, repair packages for maintenance are calculated statically, that is to say that at a time, the analysis is performed without the resume thereafter. The idea of this study is to make it easy to recalculate these packages (dynamic approach). One can very well imagine that we started working with components whose reliability is not optimal. These components are then included in the repair packages until you decide to change providers that optimize reliability. These components remain in the packages although they are now more reliable.

The paper is structured as followed. Section 2 exposes a situational analysis performed prior to the formulation of our proposal. Section 3 presents the methodology adopted for experience feedback reuse applied to industrial maintenance management. Section 4 presents an illustrative case study with the suggested technical

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solution. Finally, Section 5 discusses the work we have done to criticize the solutions and related future challenges.

2. Maintenance activities in the target railway industry: a situational analysis

2.1. Definition of requirements

This analysis allowed us to identify what are the possible entries into the study environment and what has to be created with the assumptions that arise as proposed answer to the question of starting data. Upstream, the knowledge of various experts is materialized in the form of expert reports. Downstream maintenance wants to quickly repair products based on symptoms or change parts in advance. The feedback will create packages that will be used by maintenance services; we consider that these packages do improve the quality of maintenance actors by making them more reactive in order to meet their customers' demands.

Most vividly, we can now reformulate the subject as follows: "Analysis of feedback to improve the response time for maintenance services."

Table 1 presents some of the questions asked at the beginning of this research work and gives the starting-point for the reflections in this document. The adopted approach is related to the issue of "Analysis of feedback to improve the response time for maintenance services".

To answer this issue, we need a tool to integrate experience feedback processes from various experts and conflict management to create maintenance packages. This experience feedback will be an interface between experts formalizing their knowledge and maintenance service that will set packages:

- Main function service:
  - FP1: Capitalizing on experienced knowledge of the maintenance service to be more responsive to the needs.
- Secondary function service:
  - FS11: Recording experience feedback information from experts.
  - FS12: To provide rapid and effective assistance in repair packages for commercial teams of the maintenance service.
- Function constraints:
  - FC13: The experience feedback processes must be correctly executed to reduce the risk of losing valuable information from previous failure cases.
  - FC14: The conception of maintenance packages must be reviewed, updated or appropriately adjusted when necessary.
  - FC15: Protect the recorded data in order to guarantee their integrity, nature and sources.

Fig. 1 describes a diagram of interactions that provides a high-level representation of some interactions between the intelligence analysis program and other components (Experts, Maintenance Service, Experience Feedback and Packages). The diagram of interactions can help to understand the different relationships (information flows and knowledge sharing) between a given group of actors and other stakeholders.

Table 1
Analysis of feedback to improve the response time for maintenance services.

Objective: improving quality and responsiveness of maintenance service	
Who for?	Maintenance services of railway industries
When?	At each requests to the maintenance service
Where?	Maintenance services for traction systems
What?	Service quality improvements
How?	Experience feedback analysis and packages creation
Why?	Improving maintenance-processing while increasing customer satisfaction with revenue enhancement and inventory control

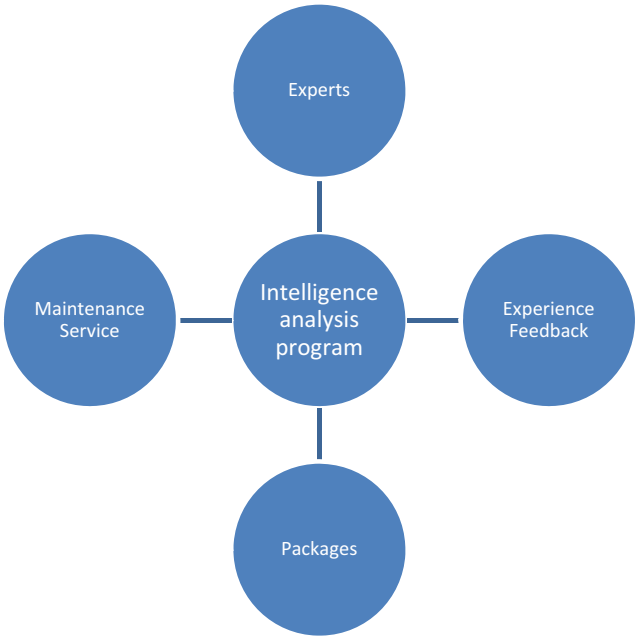

Fig. 1. The diagram of interactions.

As a first step, one has to start by examining the principle of creating packages with various mechanisms. Therefore we will focus in this task which constitutes the means of implementation of the essential dimensions of clarity, feasibility and relevance of the scientific process and the construction of the work that the original question suggests. The search for solutions is carried out in an open and transparent manner meaning that the problem-solving system may exhibit many different responses provided regarding the orientations to be fostered for the maintenance. An initial question still addresses existing propositions with statements that bridge "the best of what is or has been" and investigations about "what might be". Following the definition of the conceptual elements of the revised framework for the maintenance service, we define the scope of proposed approach, create a processing plan, identify constraints, associated rules and project management requirements, and establish problem solving reasoning and mechanisms requirements.

2.2. Maintainability assessment in industrial devices

The knowledge exploitation in industrial settings can be guided by the maintainability indicators and maintenance levels description. The information from analysis phase can be a guide to knowledge exploitation and case management regarding maintainability requirements. In addition, they also define their relationship with the relevant attributes for continuous improvement. For example, the attributes of device maintainability may be presented as its design quality, specific industrial environment and of logistics support [10]:

- Attributes related to the device design: Simplicity, Identification, Modularity, Tribology, Standardization, Failure watch, Accessibility and Assembly/disassembly.
- Attributes related to the maintenance staff and work conditions: Ergonomics, Training and Environment.
- Attributes related to the necessity of logistics support: Relation with the manufacturer, Personnel organization, Spare parts,